Section B

Status of animal genetic resources

1 Introduction

This section presents a global overview of the diversity and status of AnGR. The analysis is based on FAO's Global Databank for Animal Genetic Resources for Food and Agriculture (Global Databank), as it is the only such resource that provides worldwide coverage. It serves as an updated (but condensed) version of the World Watch List for Domestic Animal Diversity[2] (WWL–DAD), the previous (third) edition of which was published in 2000. Box 4 outlines changes in the approach to reporting and data analysis that have been introduced for the State of the World's Animal Genetic Resources for Food and Agriculture (SoW-AnGR) preparation process. The section begins by describing the state of reporting on AnGR, and the progress made during the period December 1999 to January 2006. A description of the current regional distribution of livestock species and breeds is then presented, followed by an overview of the risk status of the world's livestock breeds. Finally, trends in risk status over this six year period are assessed.

[2] FAO/UNEP 2000. *World watch list for domestic animal diversity*, 3rd edition, edited by B.D. Scherf, Rome. (also available at http://www.fao.org/dad-is).

2 State of reporting

The total number of breed records in the Global Databank has increased greatly since the publication of the WWL–DAD:3 (Table 5). The total number of entries rose from 6 379 in December 1999 to 14 017 in January 2006. The increase was particularly marked in the case of avian breed populations, for which the number of records increased from 1 049 to 3 505. In the case of mammalian species the number rose from 5 330 to 10 512. Nearly all breed populations reported (94 percent) are domesticated livestock, only 1 percent are feral, and less than 1 percent

TABLE 5
Status of information recorded in the Global Databank for Animal Genetic Resources

Year of analysis	Mammalian species		Avian species		Countries covered
	Number of national breed populations	% with population data	Number of national breed populations	% with population data	
1993	2 719	53	-	-	131
1995	3 019	73	863	85	172
1999	5 330	63	1 049	77	172
2006	10 512	43	3 505	39	182*

*No data recorded for Andorra, Brunei Darussalam, Gaza Strip, Holy See, Liechtenstein, Marshall Islands, Federated States of Micronesia, Monaco, Nauru, Qatar, San Marino, Singapore, Timor-Leste, United Arab Emirates, West Bank, Western Sahara.

are wild populations (for the remaining 4 percent no specification was given).

While the number of breeds recorded has increased, the percentage of breeds for which population data are available, decreased from 77 to 39 percent for avian breeds, and from 63 to 43 percent for mammalian breeds (Table 5 and Figure 5). Furthermore, where population figures are reported, they may not have been updated recently. The large discrepancy between the number of breed entries and the number for which population data are available is in part accounted for by the fact that much of the latest data entered into the Global Databank were extracted from Country Reports. These reports often mention the existence of breeds, but do not include details of population size.

Before analysis of the global state of breed diversity and risk status could be undertaken, some adjustments to the raw figures for the

Box 4
What is new compared to the World Watch List for Domestic Animal Diversity?

In 1991, FAO initiated global breed surveys to report on the seven major mammalian domestic animal species (ass, buffalo, cattle, goat, horse, pig and sheep). Additional surveys were initiated in 1993 to include yaks, the six camelid species and the 14 major avian species. Collection of data for deer species and rabbits followed, and these species were included in the third edition of the World Watch List for Domestic Animal Diversity (WWL–DAD:3) published in 2000. In order to produce a more complete inventory, FAO provided, during 2005, for the extraction of breed-related data from 169 Country Reports, and the entry of these data into the Global Databank for Animal Genetic Resources. Subsequently, National Coordinators (NCs) were requested to validate and further complete their national breed databanks.

The WWL–DAD:3 (2000) was criticized for overestimating the number of breeds categorized as being "at risk". This overestimation occurred because risk status was assigned to each national breed population based on the population size in the particular country. Thus, in the case of breeds that occur in more than one country, there was a danger that the categorization was not a true reflection of risk status. This problem had previously been recognized, but at the time the emphasis of reporting was on local breeds. For the SoW-AnGR process, countries decided to consider all their AnGR (both local and imported). The number of breeds wrongly categorized as being at risk would, therefore, have greatly increased. The new analysis attempts to correct this bias by linking national breed populations that belong to a common gene pool. This linkage was implemented based on expert knowledge and revised by NCs. However, a clear definition of what constitutes a common gene pool is still lacking. The linked breeds are referred to as transboundary breeds (Box 5). Risk status for these breeds is estimated based on the overall number of animals belonging to the breed in question.

The method of assessing breed diversity at regional and global levels has also been adapted: at the regional level, breeds that reside in more than one country, but only within the SoW-AnGR region in question, are now counted only once for the region regardless of how many national-level populations there may be. International transboundary breeds, which occur in many regions, are counted only once at the global level.

When comparing the WWL–DAD:3 with the figures provided in this Report, it must be noted that the classification of regions has also been changed. Southwest Pacific and Asia are here considered to be separate regions, while "Asia and the Pacific" was considered a single region in WWL–DAD 3. Moreover, it should be noted that the regional classification used in this Report is also different from the standard FAO regional classification.

Box 5
Glossary: populations, breeds, regions

Wild populations: represent either wild relatives of domesticated livestock, wild populations that are used for food and agriculture, or populations undergoing domestication.

Feral populations: animals are considered to be feral if they or their ancestors were formerly domesticated, but they are now living independently of humans; for example, dromedaries in Australia.

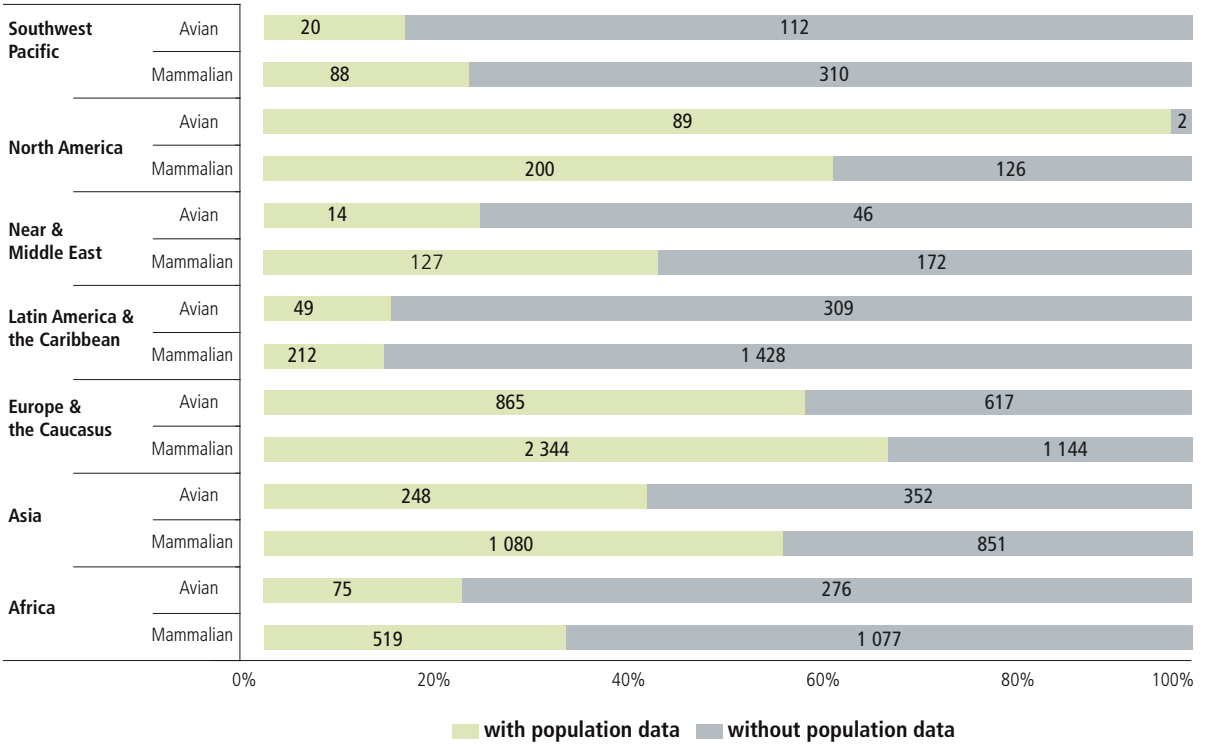
Local breeds: breeds that occur only in one country.

Transboundary breeds: breeds that occur in more than one country. These are further differentiated as:

- **Regional transboundary breeds:** transboundary breeds that occur only in one of the seven SoW-AnGR regions.
- **International transboundary breeds:** transboundary breeds that occur in more than one region.

SoW-AnGR regions: seven regions were defined for the SoW-AnGR: Africa, Asia, Europe and the Caucasus, Latin America and the Caribbean, the Near and Middle East, North America, and the Southwest Pacific.

FIGURE 5
Proportion of national breed populations for which population figures have been reported



number of breed populations were required. Four hundred and eighty entries classified as "strains" or "lines" were excluded from the analysis (in the case of avian species, further validation by national and regional experts to link lines and strains to the respective breeds is needed). Furthermore, 209 breed populations that obviously belonged to the same breed, but had been reported twice from the same country were excluded. These adjustments left a total of 13 328 breed populations for inclusion in the analysis of diversity and risk status.

Slightly more than half of the total number of recorded national breed populations (6 792 entries) occur in more than one country. These breed populations have been linked and are defined as "transboundary" breeds (Box 5). The risk status assigned to a transboundary breed takes into account all reported populations for the breed in question. Breed populations occurring only in one country are defined as "local" breeds. Transboundary breeds are classified as either "regional" or "international", depending on the extent of their distribution (Box 5).

TABLE 6
Distribution of mammalian species by region

Mammalian species	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific
	percentage of countries in a region reporting breed-related information for the species						
Buffalo	8	57	25	27	25	0	8
Cattle	98	96	100	94	75	100	77
Yak	0	32	2	0	0	0	0
Goat	96	96	93	94	83	100	69
Sheep	92	86	100	91	100	100	31
Pig	70	82	91	91	8	100	92
Ass	38	46	36	39	50	50	
Horse	46	93	91	64	58	100	23
Bactrian camel	0	25	5	0	0	0	0
Dromedary	32	25	2	0	58	0	8
Alpaca	2	0	0	12	0	0	8
Llama	0	0	0	15	0	0	0
Guanaco	0	0	0	9	0	0	0
Vicuña	0	0	0	12	0	0	0
Deer*	2	25	14	9	0	50	15
Rabbit	38	39	39	48	8	0	0
Guinea pig	8	0	0	15	0	0	0
Dog	2	7	5	0	0	0	0

Shading: purple: ≥50% of countries; green: <50% of countries and ≥10% of countries; yellow: <10% of countries; white: no country.

*The main deer species under domestication are the Red deer (*Cervus elaphus elaphus*), Sika deer (*C. nipon nipon*), Wapiti (*C. elaphus canadensis*), Sambar (*C. unicolor unicolor*), Hog deer (*Axis porcinus*), Fallow deer (*Dama dama*), Rusa or Javan deer (*C. timorensis russa*), Chital or Axis deer (*Axis axis*), Reindeer/Caribou (*Rangifer tarandus*), Musk deer (*Moschus moschiferus*), Pere David's deer (*Elaphurus davidianus*) and the Moose/Elk (*Alces alces*).

TABLE 7
Distribution of avian species by region

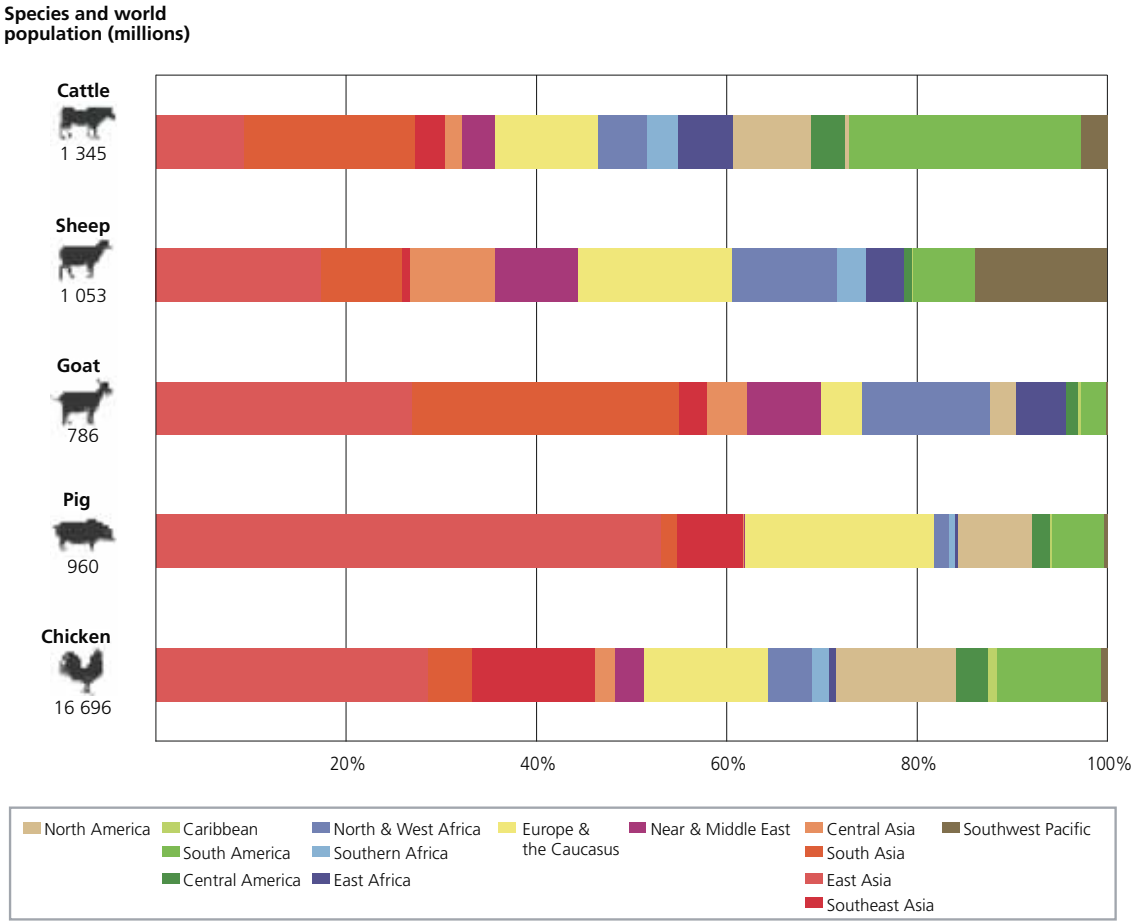
Avian species	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific
	percentage of countries in a region reporting breed-related information for the species						
Chicken	78	93	86	70	50	100	85
Duck (domestic)	32	61	50	33	17	0	46
Turkey	24	43	57	30	17	100	8
Goose (domestic)	16	39	61	21	17	50	8
Muscovy duck	16	39	20	18	17	0	62
Guinea fowl	28	18	11	9	8	0	0
Partridge	4	7	7	0	0	0	0
Pheasant	0	7	9	6	0	0	0
Quail	2	39	14	6	0	50	0
Peacock	0	0	0	3	0	0	0
Pigeon	10	21	9	6	17	0	15
Swallow	0	4	0	0	0	0	0
Cassowary	0	4	2	0	0	0	0
Emu	2	4	2	3	0	0	8
Ñandu	0	0	2	6	0	0	0
Ostrich	12	11	7	0	0	0	8

Shading: purple: ≥50% of countries; green: <50% of countries and ≥10% of countries; yellow: <10% of countries; white: no country.

3 Species diversity

Only about 40 of the 50 000 known avian and mammalian species have been domesticated. DAD-IS now reports breed-related information on 18 mammalian species (Table 6), 16 avian species (Table 7) and two fertile interspecies crossings (Bactrian camel × dromedary, and duck × Muscovy duck). On a global scale, five species – cattle, sheep, chickens, goats, and pigs – show widespread distribution and particularly large numbers. The first three are the most widely distributed domestic species globally, while the latter two are less evenly spread (Figure 6, Tables 6 and 7). Goats are much less numerous in the Americas, and Europe and the Caucasus, than in other regions; and, for religious reasons, pigs are notably lacking in Muslim countries.

FIGURE 6
Regional distribution of major livestock species in 2005

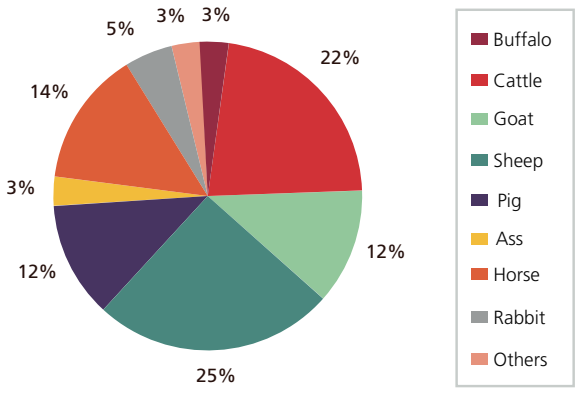


Source: FAOSTAT (available at http://faostat.fao.org).

3.1 The big five

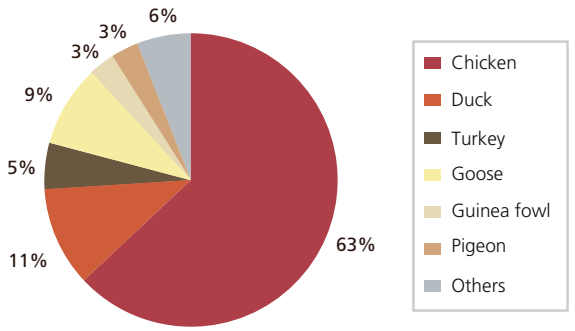
The world has over 1.3 billion cattle – about one for every five people on the planet. Cattle are important in all seven regions. Asia (most notably India and China) with 32 percent of the world total, and Latin America with 28 percent (Brazil has the world's largest cattle population), are the dominant regions for this species (Figure 6). Large cattle populations are also found in Africa (highest numbers in the Sudan and Ethiopia), and Europe and the Caucasus (highest numbers in the Russian Federation and France). Elsewhere, the United States of America and Australia have large national herds. Cattle breeds contribute

FIGURE 7
Distribution of the world's mammalian breeds by species



Mammalian species with more than 100 recorded breeds are displayed separately; the remaining mammalian species are aggregated as others.

FIGURE 8
Distribution of the world's avian breeds by species



Avian species with more than 50 recorded breeds are displayed separately; the remaining avian species are aggregated as others.

22 percent of the world's total number of recorded mammalian livestock breeds (Figure 7).

The world's sheep population is just over one billion – one for roughly every six people. Nearly half are found in Asia and the Near and Middle East (largest populations in China, India and the Islamic Republic of Iran); Africa, Europe and the Caucasus, and the Southwest Pacific have around 15 percent each; and 8 percent are found in Latin America and the Caribbean. In contrast to goats, which are largely restricted to developing regions, several developed countries, most notably Australia, New Zealand and the United Kingdom, also have large sheep populations. Sheep are the species with the highest number of recorded breeds (contributing 25 percent to the global total for mammals).

There are about a billion pigs in the world – one for every seven people. About two-thirds are found in Asia – the vast majority in China, with significant numbers also in Viet Nam, India and the Philippines. Europe and the Caucasus has a fifth of the world's pigs, and the Americas another 15 percent. Pig breeds contribute 12 percent to the total number of recorded mammalian breeds in the world.

Goats are the least numerous of the five major livestock species. There are about 800 million worldwide – one for every eight people. Some 70 percent of the world's goats are in Asia and the Near and Middle East, with the largest populations being found in China, India and Pakistan. Africa accounts for most of the rest of the world's goats, with only about 5 percent being found in Latin American and the Caribbean, and Europe and the Caucasus. Goat breeds contribute 12 percent to the total number of recorded mammalian breeds in the world.

Chickens outnumber humans by 2.5 to 1 worldwide. There are nearly 17 billion, about half of which are in Asia, and another quarter in Latin America and the Caribbean. Europe and the Caucasus has a further 13 percent of the world's flock, followed by Africa with 7 percent. Chicken breeds make up a large majority of the total number of avian breeds in the world (Figure 8).

3.2 Other widespread species

Horses, asses and ducks are also found in all regions; however, they are less numerous than the five species discussed above, and show a less even distribution than cattle, sheep and chickens.

The world's 54 million horses are widely distributed. The country with the largest number is China, followed by Mexico, Brazil, and the United States of America. Other countries with over a million horses are Argentina, Colombia, Mongolia, the Russian Federation, Ethiopia and Kazakhstan. The contribution of horse breeds to the total number of mammalian breeds in the world (14 percent) far outweighs their contribution in terms of animal numbers.

Asses are the transport animal of the poor and of areas that lack a well-developed transport infrastructure. As such, they are predominantly found in the developing regions of the world. The largest numbers are in Asia, Africa, and Latin America and the Caribbean. They are also widely distributed in the Near and Middle East.

The country with the largest ass population is China, where Mao Zedong popularized the animal to decrease the drudgery of rural women. Breed diversity is thought to be less than in other species; asses contribute only 3 percent to the world's total number of recorded mammalian breeds. However, asses – and research on them – are often stigmatized, so it is likely that many breeds have not yet been reported.

Domestic ducks show an even less homogenous pattern of distribution than asses. They have a long history of domestication, and were kept in ancient Egypt, Mesopotamia, China and the Roman Empire. However, production is now concentrated in China, which has 70 percent of the world's domestic duck population. Other major producers are Viet Nam, Indonesia, India, Thailand and other countries in Southeast Asia. Among European countries, France and Ukraine have large numbers of ducks. Duck breeds (excluding Muscovy ducks) contribute 11 percent to the total number of recorded avian breeds in the world.

3.3 Species with a narrower distribution

Some mammalian species, such as buffaloes, yaks, camelids and rabbits, and some avian species, such as domestic geese and turkeys, have a narrow distribution and are of particular importance in one or two regions or in a specific agro-ecological zone.

The domestic buffalo is originally an Asian animal – 98 percent of the world's herd of 170 million animals are found in this region, principally in India, Pakistan, China and Southeast Asia. It has been introduced to south and southeastern Europe, as well as to Egypt, Brazil, Papua New Guinea and Australia. Buffaloes are now reported from 41 countries worldwide. There are two main types of buffalo: riverine (from South Asia), an important dairy producer especially in South Asia; and swamp (from East Asia) which played a major role as a working animal in wet rice cultivation in Southeast Asia until the introduction of the "iron buffalo" – the hand tractor. Buffalo breeds contribute 3 percent to the world's total number of recorded mammalian breeds.

The yak is endemic to the Tibetan plateau. The largest populations are in China and Mongolia, with small numbers present in the Russian Federation, Nepal, Bhutan, Afghanistan, Pakistan, Kyrgyzstan and India. In many parts of the Himalaya, yak hybrids with cattle are extremely important. Yaks have also been introduced to the Caucasus, North America (3 000 animals), and many countries in Europe. The total number of recorded yak breeds is small, which reflects the narrow geographical and agro-ecological distribution of the species.

Dromedaries, and particularly Bactrian camels, also have quite a narrow geographical distribution, and are confined to more arid agro-ecological zones. Accordingly, their share of breed diversity is relatively small. The dromedary, or one-humped camel, plays an important role in the Near and Middle East, Africa and Asia. In Asia, the camel population is currently in stark decline, although it is stable in Africa. In Africa, Somalia, the Sudan, Mauritania and Kenya have the largest populations, while India and Pakistan account for most Asian camels. The two-humped Bactrian camel is confined largely to Central and East Asia, with Mongolia and China having the largest populations.

Four species of camelids originate in South America: the domesticated llama and alpaca, and the wild guanaco and vicuña. The vast majority of llamas are found in Peru and Bolivia; small numbers are found in zoos and among hobbyists in other countries. Guanacos and vicuñas are utilized for fibre, hide and meat production. The total number of recorded camelid breeds is small compared to many other livestock species. The South American species are very largely restricted to the one region and to high altitudes.

The majority of the world's farmed rabbits are found in Asia, with the largest population being in China. Large populations are also found in several Central Asian countries and in the Democratic People's Republic of Korea. In Europe

and the Caucasus, the largest population is found in Italy. Rabbit breeds make up 5 percent of the total number of recorded mammalian breeds in the world. Guinea pigs are significant only in the Latin American and the Caribbean region, largely in Peru and Bolivia.

Domestic geese and turkeys also have a relatively narrow distribution. This distribution can be explained by tradition and consumer preferences rather than by agro-ecological conditions. Nearly 90 percent of the world's domestic geese are found in China. Egypt, Romania, Poland and Madagascar together have more than half of the rest. Turkeys originated in Central America. They were brought to Europe shortly after their discovery by colonists, and many distinct breeds were developed in Europe. Europe and the Caucasus is the region with the largest population of domestic turkeys (43 percent), while North America has over one-third of population. Goose and turkey breeds contribute 9 and 5 percent respectively to the global total of avian breeds.

4 Breed diversity

4.1 Overview

A global total of 7 616 breeds have been reported; 6 536 are local breeds and 1 080 are transboundary breeds. Among the transboundary breeds, 523 are regional transboundary breeds occurring only in one region (1 413 national-level entries); and 557 are international transboundary breeds with a wider distribution (5 379 national-level entries). A total of 690 breeds are classified as extinct, of which nine are transboundary breeds. In the following analysis of breed diversity, extinct breeds are excluded.

Figure 9 shows the share of local, regional transboundary and international transboundary breeds among the mammalian and avian breeds of the world (excluding extinct breeds). More than two-thirds of reported breeds belong to mammalian species. The numbers of regional and international transboundary breeds are quite similar in mammalian species, while in avian species there are twice as many international transboundary breeds as there are regional transboundary breeds.

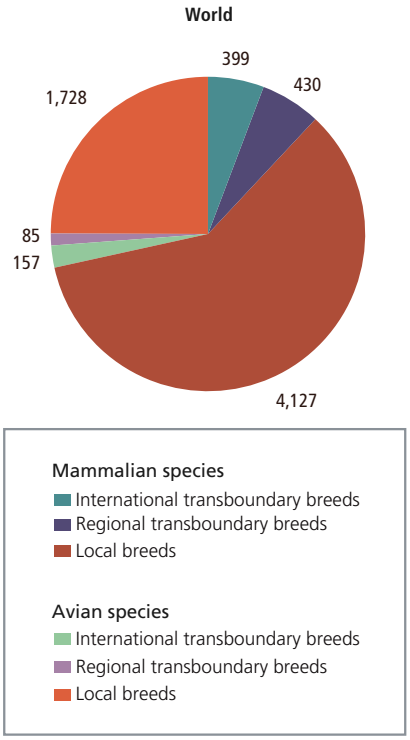
In all regions of the world, mammalian breeds outnumber avian breeds. In all regions except for Europe and the Caucasus, mammalian breeds make up nearly three-quarters of all breeds reported. There is, however, considerable variation between regions in terms of the share of the three breed categories in the total number of breeds (Figure 10). In Europe and the Caucasus, Asia, and the Near and Middle East, local breeds make up about three-quarters of all breeds. In Africa, and Latin America and the Caribbean, the share of local breeds is smaller, but still exceeds two-thirds of all breeds. Conversely, international transboundary avian and mammalian breeds dominate in the Southwest Pacific and North America. Regional transboundary mammalian breeds are relatively numerous in Europe and the Caucasus, Africa, and to lesser extent Asia, while it is only in Europe and the Caucasus that there are a significant number of regional transboundary avian breeds.

For the assessment of the breed diversity being maintained in the regions, international transboundary breeds were excluded, as they cannot be assigned to a particular region. Europe and the Caucasus, and Asia are home to the largest share of breeds of most of the world's major livestock species (Table 8). Camels are the exception, with the largest number of breeds being found in Africa. In terms of population size, Asia is the dominant region for most species. Exceptions include camels (Africa), turkeys (Europe and the Caucasus) and horses (44 percent of which are found in Latin America and the Caribbean).

It can be seen from Table 8 that the Europe and the Caucasus region's share of breeds is far higher than its population share in most species. The turkey is an exception to the pattern. Although the region's share of breeds is the highest in the world for this species, the population share is

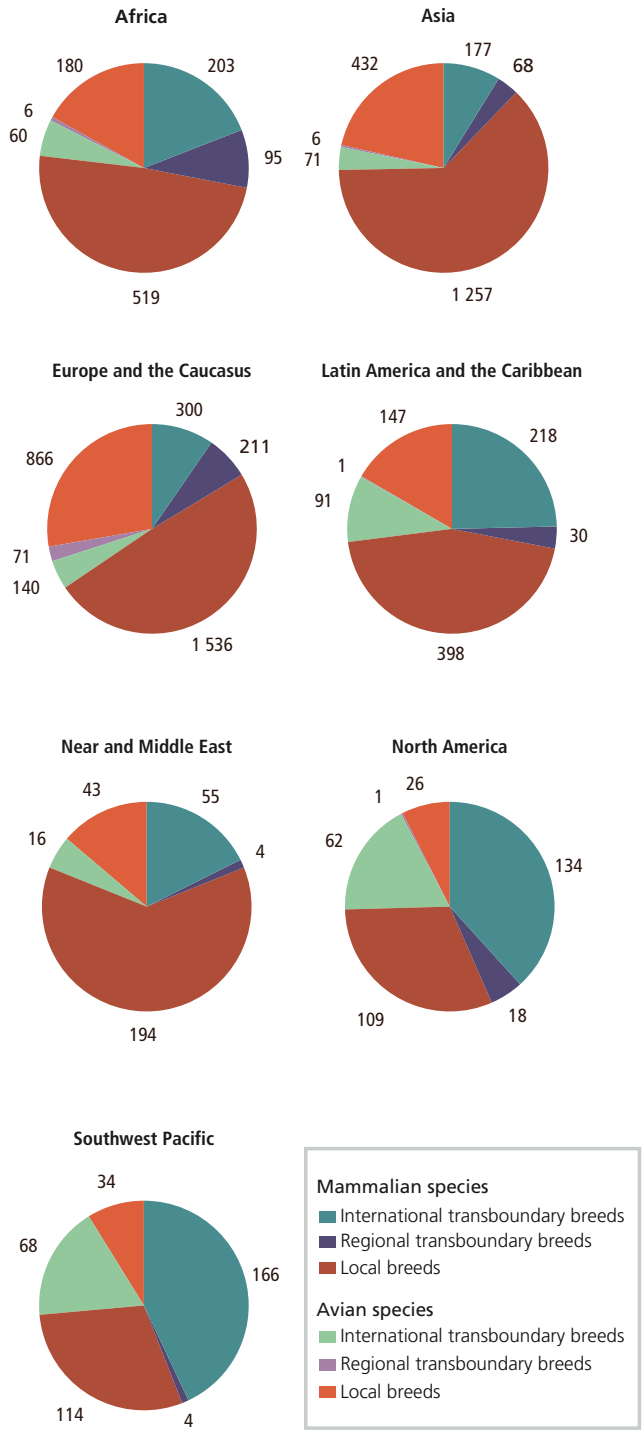
almost the same. The large number of breeds in Europe and the Caucasus is partly a result of the fact that many of these breeds are recognized as separate entities, but are in fact closely related genetically. It also reflects the more advanced state of breed recording and characterization in this region, compared for example, to most parts of sub-Saharan Africa where efforts are restricted by a lack of technical and human resources. Asia also accounts for a high proportion of the world's breeds in many species, but the region's share of the total population is in most cases even higher (exceptions are turkeys, and Bactrian camels and dromedaries).

FIGURE 9
Number of local and transboundary breeds at global level



Please note that for these figures international transboundary breeds are counted once in each region, where they occur. Thus, international transboundary breeds are counted more than once.

FIGURE 10
Number of local and transboundary breeds at regional level



Values show the number of breeds belonging to each group present in the respective region.

TABLE 8

Proportion of the world's population size (2005) and number of local and regional transboundary breeds (January 2006) of the major livestock species by region

Species	Africa		Asia		Europe & the Caucasus		Latin America & the Caribbean	
	pop. (%)	breed (%)	pop. (%)	breed (%)	pop. (%)	breed (%)	pop. (%)	breed (%)
Buffalo	0	2	97	73	0	9	1	9
Cattle	14	19	32	26	11	31	28	14
Goat	22	18	62	35	4	33	4	5
Sheep	16	12	36	25	18	48	7	4
Pig	2	9	62	41	20	32	8	12
Ass	27	14	38	28	4	28	20	15
Horse	6	7	25	24	13	48	44	11
Bactrian camel & dromedary	40	47	20	24	2	3	0	0
South American camelids	0	0	0	0	0	0	100	100
Rabbit	0	7	74	8	24	76	1	7
Chicken	6	8	48	22	14	58	15	8
Duck & Muscovy duck	1	9	90	38	7	36	2	11
Turkey	3	13	1	13	43	42	18	13
Goose	1	6	90	24	6	65	0	3

Species	Near & Middle East		North America		Southwest Pacific		World	
	pop. (%)	breed (%)	pop. (%)	breed (%)	pop. (%)	breed (%)	pop. (million head)	breed number
Buffalo	2	6	0	0	0	2	174	132
Cattle	3	4	8	3	3	3	1 355	990
Goat	8	6	0	1	0	2	808	559
Sheep	9	5	1	3	14	3	1 081	1 129
Pig	0	0	8	3	0	2	960	566
Ass	12	11	0	3	0	2	41	150
Horse	0	2	11	4	1	4	55	633
Bactrian camel & dromedary	38	24	0	0	0	2	19	97
South American camelids	0	0	0	0	0	0	6	13
Rabbit	2	2	0	0	0	0	537	207
Chicken	3	2	13	1	1	2	16 740	1 132
Duck & Muscovy duck	1	2	1	0	0	4	1 046	234
Turkey	1	4	33	13	1	2	280	85
Goose	3	1	0	0	0	1	302	166

4.2 Local breeds

Tables 9 and 10, respectively, show the number of local breeds of mammalian and avian species for each region of the world. For most livestock species, Europe and the Caucasus or Asia are the regions that have the highest number of local breeds. The dromedary, with most breeds located in Africa and the Near and Middle East, is an exception to this pattern.

TABLE 9

Mammalian species – number of reported local breeds

Species	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific	World
Buffalo	2	88	11	11	8	0	2	122
Cattle	154	239	277	129	43	29	26	897
Yak	0	26	1	0	0	0	0	27
Goat	86	182	170	26	34	3	11	512
Sheep	109	265	458	47	50	31	35	995
Pig	49	229	165	67	1	18	12	541
Ass	17	39	40	21	16	4	3	140
Horse	36	141	269	65	14	23	22	570
Dromedary	44	13	1	0	23	0	2	83
Rabbit	11	16	125	14	5	0	0	171
Total	508	1 246	1 519	380	194	108	113	4 068

Excludes extinct breeds. Not shown: alpaca, deer, dog, dromedary × Bactrian camel, guanaco, guinea pig, llama, vicuña.

TABLE 10

Avian species – number of reported local breeds

Species	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific	World
Chicken	89	243	608	84	24	12	17	1 077
Duck	14	76	62	22	4	1	7	186
Turkey	11	11	29	11	3	11	2	78
Goose	10	39	100	5	2	0	2	158
Muscovy duck	7	10	10	3	1	0	3	34
Partridge	2	8	3	0	0	0	0	13
Pheasant	0	7	5	6	0	0	0	18
Pigeon	7	12	30	7	8	1	2	67
Ostrich	6	2	4	0	0	0	1	13
Total	146	408	851	138	42	25	34	1 644

Excludes extinct breeds. Not shown: cassowary, duck × Muscovy duck, emu, guinea fowl, ñandu, peacock, quail, swallow.

4.3 Regional transboundary breeds

For several species, including sheep, horses, pigs, and all avian species, Europe and the Caucasus, has the highest number of regional transboundary breeds. However, as Table 11 shows, a relatively large share of such breeds is also found in Africa. The latter region is dominant in terms of the numbers of regional transboundary breeds of cattle, goats and asses. Europe and the Caucasus, however, has by far the highest number of regional transboundary breeds among avian species (Table 12). The existence of significant numbers of regional transboundary breeds clearly has implications for management and conservation of AnGR, and highlights the need for cooperation at regional or subregional levels.

TABLE 11

Mammalian species – number of reported regional transboundary breeds

Species	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific	World
Buffalo	0	8	1	1	0	0	0	10
Cattle	35	19	28	8	0	3	0	93
Goat	15	11	13	2	0	5	1	47
Sheep	27	13	79	2	4	6	3	134
Pig	2	2	17	3	0	1	0	25
Ass	4	3	2	1	0	0	0	10
Horse	7	10	38	5	0	3	0	63
Dromedary	2	1	0	0	0	0	0	3
South American camelids				6				6
Deer		1	1					2
Rabbit	3	0	32	1	0	0	0	36
Guinea pig				1				1
Total	95	68	211	30	4	18	4	430

Excluding extinct breeds.

TABLE 12
Avian species – number of reported regional transboundary breeds

Species	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	North America	World
Chicken	6	2	45	1	1	55
Duck	0	2	12	0	0	14
Turkey	0	0	7	0	0	7
Goose	0	1	7	0	0	8
Quail	0	1	0	0	0	1
Total	6	6	71	1	1	85

Excluding extinct breeds.

4.4 International transboundary breeds

Cattle, sheep, horses and chickens are the species that have the highest numbers of international transboundary breeds (Tables 13 and 14).

TABLE 13
Mammalian species – number of reported international transboundary breeds

Species	Number of breeds
Buffalo	5
Cattle	112
Goat	40
Sheep	100
Pig	33
Ass	6
Horse	66
Bactrian camel	2
Dromedary	2
Deer	10
Rabbit	23
Total	399

Excluding extinct breeds.

TABLE 14
Avian species – number of reported international transboundary breeds

Species	Number of breeds
Chicken	101
Duck	12
Turkey	16
Goose	15
Muscovy duck	1
Guinea fowl	5
Pigeon	1
Cassowary	1
Emu, Ñandu, Ostrich	5
Total	157

Excluding extinct breeds.

5 Risk status of animal genetic resources

A total of 1 491 breeds (or 20 percent) are classified as being "at risk" (Box 6). Figure 11 shows that for mammalian species, the proportion of breeds classified as at risk is lower overall (16 percent) than for avian species (30 percent). However, in absolute terms, the number of breeds at risk is higher for mammalian species (881 breeds) than for avian species (610 breeds).

Figure 12 presents risk status data for mammalian species. It can be seen that cattle are the mammalian species with the highest number of breeds at risk. Horses (23 percent) followed by rabbits (20 percent) and pigs (18 percent) are, however, the species that have the highest proportions of at-risk breeds. Figure 12 also indicates the large number of breeds for which no risk status data are available. The problem is particularly significant in some species – 72 percent for rabbit breeds, 66 percent for deer, 59 percent for asses and 58 percent for dromedaries. This lack of data is a serious constraint to effective prioritization and planning of breed conservation measures. Cattle are the species with the highest number of breeds (209) reported as extinct. Large numbers of extinct pig, sheep and horse breeds are also reported. There is, however, clearly a possibility that there were breeds that became extinct before they were documented, and which are therefore missing from the analysis.

Among avian species, chickens have by far the highest number of breeds at risk on a world scale (Figure 13). This is partly related to the large number of chicken breeds in the world, but the proportion of breeds at risk is also high in chickens

Box 6
Glossary: risk status classification

extinct: a breed is categorized as extinct when there are no breeding males or breeding females remaining. Nevertheless, genetic material might have been cryoconserved which would allow recreation of the breed. In reality, extinction may be realized well before the loss of the last animal or genetic material.

critical: a breed is categorized as critical if the total number of breeding females is less than or equal to 100 or the total number of breeding males is less than or equal to five; or the overall population size is less than or equal to 120 and decreasing and the percentage of females being bred to males of the same breed is below 80 percent, and it is not classified as extinct.

critical-maintained: are those critical populations for which active conservation programmes are in place or populations are maintained by commercial companies or research institutions.

endangered: a breed is categorized as endangered if the total number of breeding females is greater than 100 and less than or equal to 1 000 or the total number of breeding males is less than or equal to 20 and greater than five; or the overall population size is greater than 80 and less than 100 and increasing and the percentage of females being bred to males of the same breed is above 80 percent; or the overall population size is greater than 1 000 and less than or equal to 1 200 and decreasing and the percentage of females being bred to males of the same breed is below 80 percent, and it is not assigned to any of above categories.

endangered-maintained: are those endangered populations for which active conservation programmes are in place or populations are maintained by commercial companies or research institutions.

breed at risk: a breed that has been classified as either critical, critical-maintained, endangered, or endangered-maintained.

(33 percent). Relatively high proportions and numbers of breeds at risk are also found among turkeys and geese. As in the case of mammalian species, there are a large number of breeds for which population figures are unavailable. Extinct breeds have mainly been reported among chickens. There are also a few cases among ducks, guinea fowls and turkeys.

Figures 14 and 15 show the distribution of breeds at risk by region for mammalian and avian species respectively. The regions with the highest proportion of their breeds classified as at risk are Europe and the Caucasus (28 percent of mammalian breeds and 49 percent of avian breeds), and North America (20 percent of mammalian breeds and 79 percent of avian breeds). Europe and the Caucasus, and North America are the regions that have the most highly specialized livestock industries, in which production is dominated by a small number of breeds. In absolute terms, Europe and the Caucasus has by far the highest number of at-risk breeds. Despite the apparent dominance of these two regions, problems in other regions may be obscured by the large number of breeds with unknown risk status. In Latin America and the Caribbean, for example, 68 percent and 81 percent of mammalian and avian breeds, respectively, are classified as being of unknown risk status, while the figures for Africa are 59 percent for mammals and 60 percent for birds.

FIGURE 11
Proportion of the world's breeds by risk status category

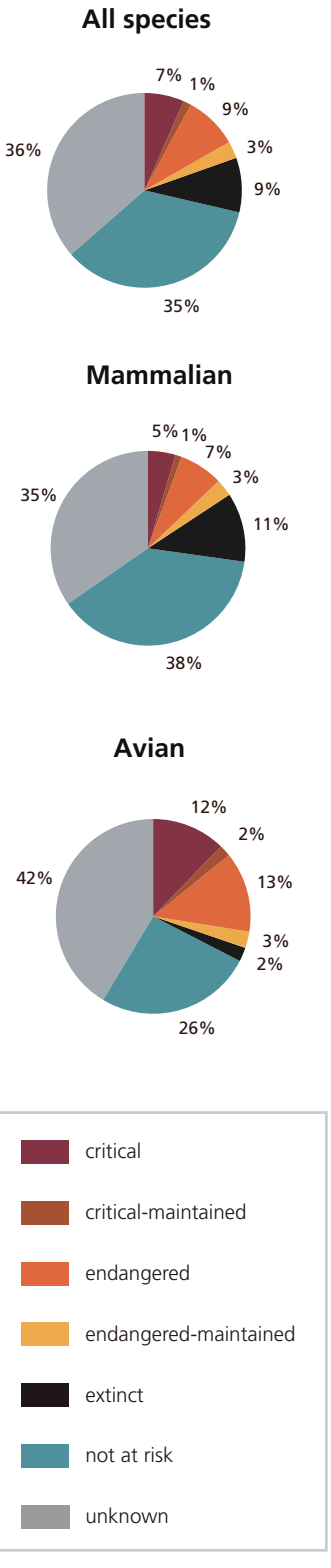
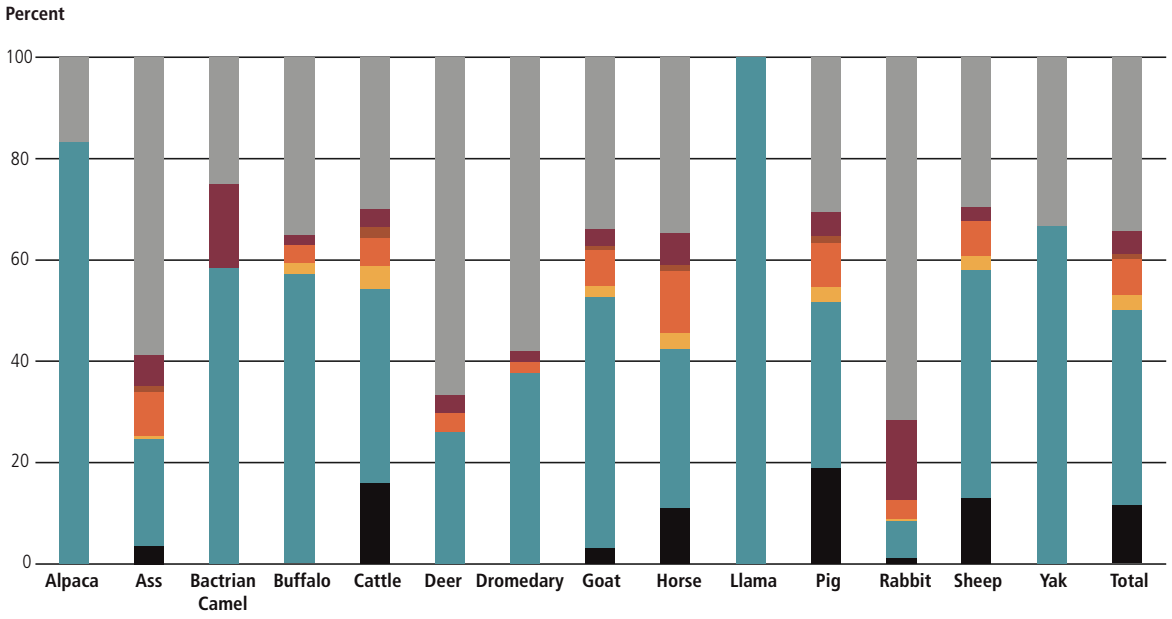


FIGURE 12
Risk status of the world's mammalian breeds in January 2006: absolute (table) and percentage (chart) figures by species



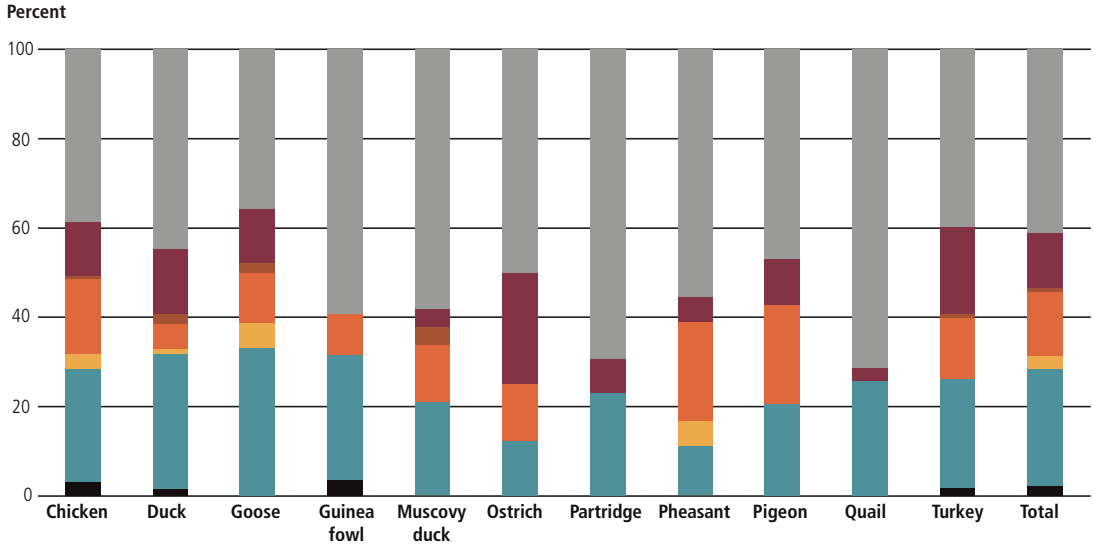
RISK STATUS

	Alpaca	Ass	Bactrian Camel	Buffalo	Cattle	Deer	Dromedary	Goat	Horse	Llama	Pig	Rabbit	Sheep	Yak	Total
unknown	1	95	3	48	393	18	51	209	272	0	225	166	417	9	1 907
critical	0	10	2	3	49	1	2	22	52	0	37	37	40	0	255
critical-maintained	0	2	0	0	26	0	0	5	10	0	11	0	5	0	59
endangered	0	14	0	5	75	1	2	44	95	0	63	9	98	0	406
endangered-maintained	0	1	0	3	60	0	0	13	24	0	22	1	36	0	160
not at risk	5	34	7	78	499	7	33	306	246	5	241	17	633	18	2 129
extinct	0	6	0	0	209	0	0	19	87	0	140	2	180	0	643
Total	6	162	12	137	1 311	27	88	618	786	5	739	232	1 409	27	5 559*

*The total number of breeds is actually higher than the number shown, as Bactrian camel × dromedary crosses, guanacos, vicuñas, guinea pigs and dogs (of which there are a total of 40 reported breeds) are not included.

FIGURE 13

Risk status of the world's avian breeds in January 2006: absolute (table) and percentage (chart) figures by species



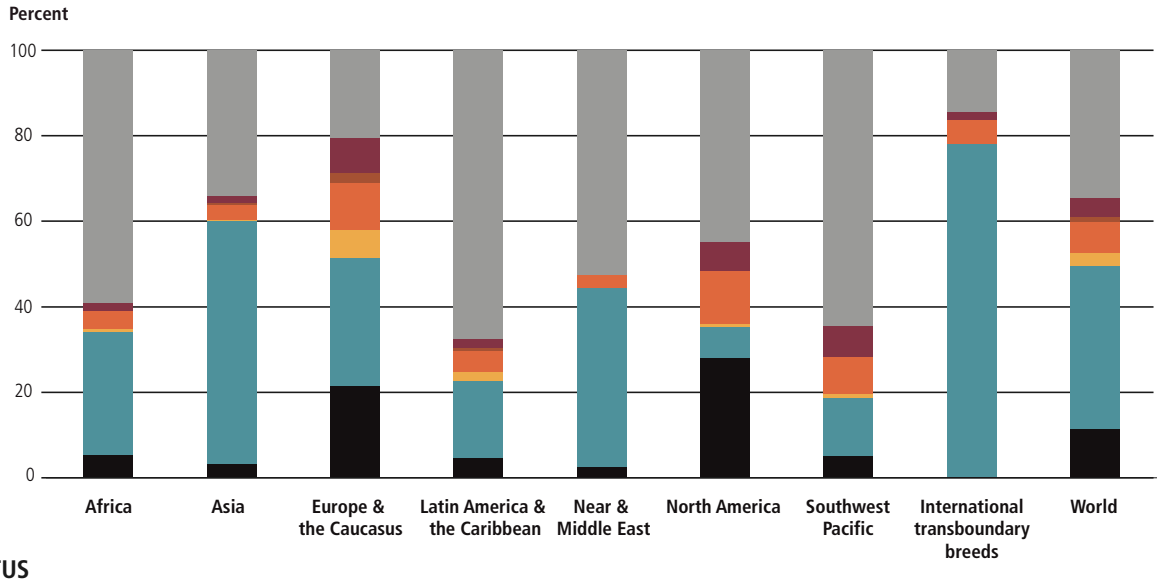
RISK STATUS

	Chicken	Duck	Goose	Guinea fowl	Muscovy duck	Ostrich	Partridge	Pheasant	Pigeon	Quail	Turkey	Total
unknown	493	96	65	32	14	8	9	10	32	25	41	825
critical	156	32	22	0	1	4	1	1	7	1	20	245
critical-maintained	9	5	4	0	1	0	0	0	0	0	1	20
endangered	212	12	20	5	3	2	0	4	15	0	14	287
endangered-maintained	42	2	10	0	0	0	0	1	0	0	0	55
not at risk	321	65	60	15	5	2	3	2	14	9	25	521
extinct	40	3	0	2	0	0	0	0	0	0	2	47
Total	1 273	215	181	54	24	16	13	18	68	35	103	2 000*

*The total number of breeds is actually higher than the number shown, as duck × Muscovy duck crossings, cassowaries, emus, ñandus, peacocks and swallows (of which there are a total of 17 reported breeds) are not included.

FIGURE 14

Risk status of the world's mammalian breeds in January 2006: absolute (table) and percentage (chart) figures by region



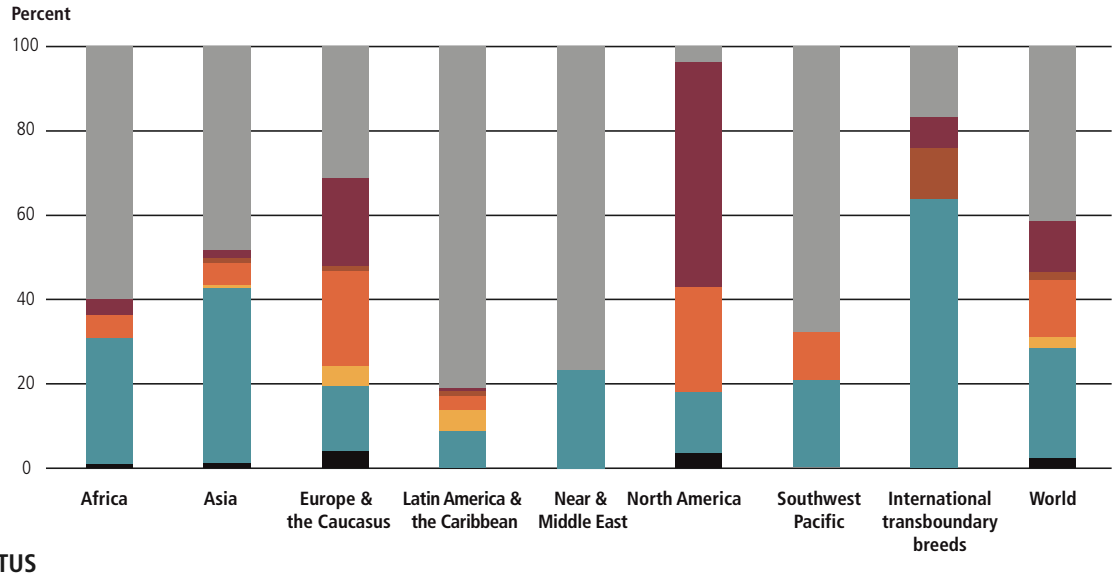
RISK STATUS

	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific	International transboundary breeds	World
unknown	384	469	459	304	107	79	80	58	1 940
critical	13	23	182	9	0	12	9	7	255
critical-maintained	0	4	51	4	0	0	0	0	59
endangered	26	50	249	21	6	22	11	22	407
endangered-maintained	4	3	142	9	0	1	1	0	160
not at risk	187	776	664	81	85	13	17	312	2 135
extinct	35	45	481	21	5	49	6	1*	643
Total	649	1 370	2 228	449	203	176	124	400	5 599

*African Aurochs, which once lived in parts of both the Africa and the Near and Middle East regions.

FIGURE 15

Risk status of the world's avian breeds in January 2006: absolute (table) and percentage (chart) figures by region



RISK STATUS

	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific	International transboundary breeds	World
unknown	113	214	305	120	33	1	23	26	835
critical	7	8	204	1	0	15	0	12	247
critical-maintained	0	6	12	2	0	0	0	19	39
endangered	10	23	220	5	0	7	4	0	269
endangered-maintained	0	3	45	7	0	0	0	0	55
not at risk	56	184	151	13	10	4	7	100	525
extinct	2	5	39	0	0	1	0	0	47
Total	188	443	976	148	43	28	34	157	2 017

TABLE 15
Number of extinct mammalian breeds

Species	Africa	Asia	Europe & the Caucasus	Latin America & the Caribbean	Near & Middle East	North America	Southwest Pacific	World
Cattle	23	18	141	19	1	4	2	209
Goat	0	2	16	0	0	1	0	19
Sheep	5	11	148	0	1	13	2	180
Pig	0	13	101	2	0	23	1	140
Ass	1	0	4	0	1	0	0	6
Horse	6	1	71	0	0	8	1	87
Rabbit	0	0	0	0	2	0	0	2
Total	35	45	481	21	5	49	6	643

TABLE 16
Number of extinct avian breeds

Species	Africa	Asia	Europe & the Caucasus	North America	World
Chicken	0	5	34	1	40
Duck	0	0	3	0	3
Turkey	0	0	2	0	2
Guinea fowl	2	0	0	0	2
Total	2	5	39	1	47

TABLE 17
Years of extinction

Year	Number of breeds	%
Before 1900	15	2
1900–1999	111	16
After 1999	62	9
Unspecified*	502	73
Total	690	100

*unspecified = no year of extinction indicated.

Tables 15 and 16 present the number of extinct mammalian and avian breeds by species and region. Europe and the Caucasus has by far the largest number of extinct mammalian and avian breeds – 16 percent of all reported breeds are extinct. However, it is the North America region that has the highest proportion of extinct breeds (25 percent) among its recorded breeds. The dominance of North America, and Europe and the Caucasus in terms of the numbers of extinct breeds, may relate to the greater levels of breed recording that have taken place in these two regions.

The year of extinction has been reported for only 27 percent (188) of extinct breeds. Fifteen breeds became extinct before the year 1900, 111 between 1900 and 1999, and within the last six years another 62 breeds became extinct (Table 17).

6 Trends in breed status

6.1 Changes in the number of breeds in the different breed groups

This subchapter describes the changes in the numbers of breeds classified as falling within each of the breed categories (local, regional transboundary and international transboundary) over the six years between December 1999 and January 2006[3]. The share of international transboundary breeds increased from 4 to 7 percent of the total during this period (from 197 to 557 breeds). This was accompanied by a slight decrease in the proportions of regional transboundary (absolute figures grew from 369 to 529 breeds) and local breeds (absolute figures grew from 4 013 to 6 536 breeds) (Figure 16).

Had the classification existed in 1999, there would have been 369 regional transboundary breeds and 197 international transboundary breeds at this time. The higher proportion of international transboundary breeds in 2006 results partly from the fact that 86 breeds that would have been classified as regional transboundary breeds in 1999 were classified as international transboundary breeds in 2006 (283 remained as regional transboundary breeds) (Table 18). The other factor contributing to the increased proportion of international transboundary breeds is that among newly reported breeds there were more international transboundary breeds (274) than regional transboundary breeds (240) (Table 18). The changes can largely be accounted for by improved reporting, but also may also reflect the ongoing spread of breeds into new regions.

[3] Note that in 1999 the breed classification system (transboundary vs. local) had not been developed, and therefore the analysis presented here was carried out by applying the new procedure to the data from 1999 to allow comparison.

FIGURE 16
Local, regional and international breeds in 1999 and 2006

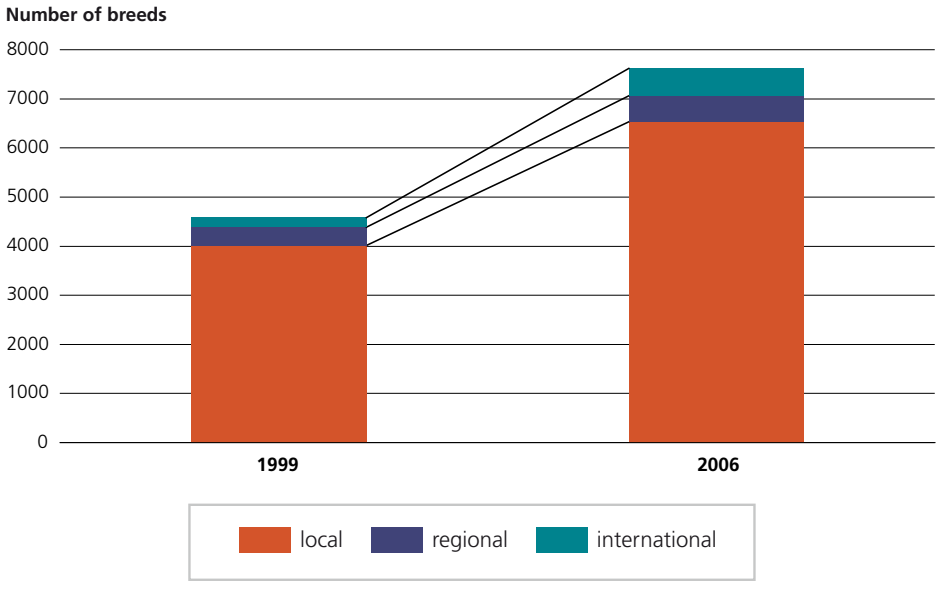


TABLE 18
Reclassification of regional and international transboundary breeds from 1999 to 2006

Year	Category	2006	
		Regional	International
1999	Regional	283	86
	International	0	197
Newly reported breeds		240	274

6.2 Trends in genetic erosion

Because of the introduction of the new transboundary breed categories in 2006, a straightforward comparison of the total number of breeds in each risk status category is not possible. Thus, the comparison is presented in three parts. Trends among transboundary breeds are shown first, followed by trends among breeds that would have been classified as local in 1999 and (because of new reports) were classified as transboundary breeds in 2006. Finally, figures are presented for breeds that would have been classified as local in 1999 and were still classified as local in 2006.

Transboundary breeds

Comparison of the data in 1999 and 2006 shows a slight reduction in the proportion of breeds assigned to the unknown risk category. This indicates some improvement in data quality – about 20 percent of the 68 breeds previously classified as being of unknown risk status were reclassified in 2006 (Figure 17; Table 19). Table 19 also shows that more breeds moved from the at risk category into the not at risk category (25 out of 80, or 31 percent) than moved in the opposite direction (10 out of 411, or 3 percent). This can largely be explained by the fact that over the six years, further countries have reported the presence of some of the transboundary breeds, which has resulted in the breeds being promoted into the not at risk category. The number of new transboundary breeds reported and their risk status categories are shown in Table 20.

FIGURE 17
Changes in risk status of transboundary breeds from 1999 to 2006

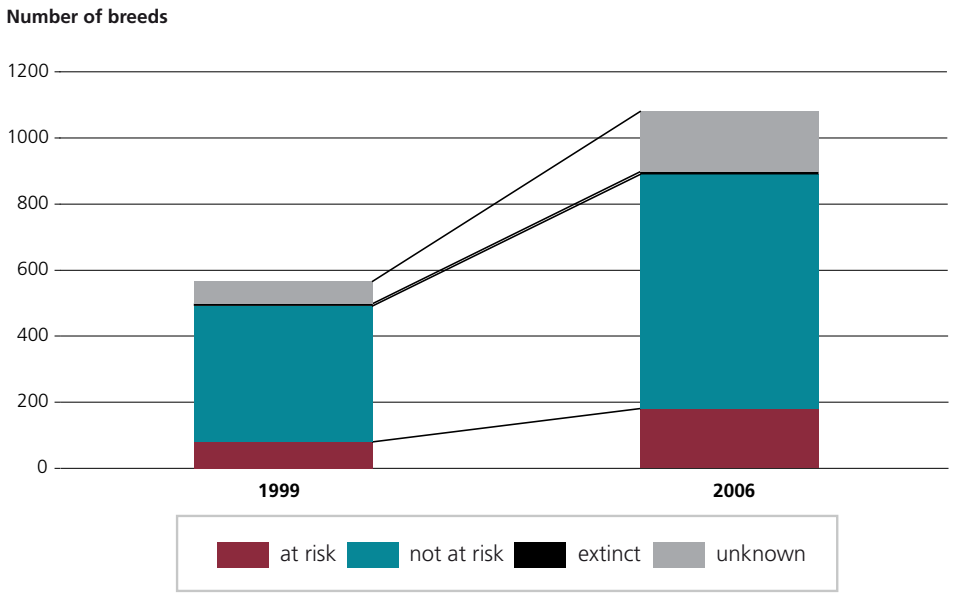


TABLE 19
Changes in risk status of transboundary breeds from 1999 to 2006

Risk status in 1999	Number of breeds in 1999	Risk status in 2006			
		at risk	not at risk	extinct	unknown
at risk	80	68%	31%	0%	1%
not at risk	411	3%	97%	0%	0%
extinct	7	0%	0%	100%	0%
unknown	68	6%	15%	0%	79%

TABLE 20
Risk status of transboundary breeds reported after 1999

	Risk status in 2006				Total number
	at risk	not at risk	extinct	unknown	
Number of breeds	112	274	2	126	514

Local breeds (1999) reclassified as transboundary breeds (2006)

Had the classification system existed in 1999, 276 breeds classified as local 1999 would have been reclassified as transboundary breeds by 2006. Of the 87 such breeds that were classified as at risk in 1999, 39 (or 45 percent) were by 2006 classified as belonging to not at risk transboundary breeds (Table 21). This can largely be accounted for by the reporting of the breeds in question from additional countries. Table 21 also shows that there has been an improvement in data quality among this group of breeds – 61 percent (34 out of 56) of breeds with an unknown risk status in 1999 were assigned to a known risk status category by 2006.

Local breeds

Over the 1999 to 2006 period, 20 percent of the breeds previously classified as being of unknown status were assigned to known risk status categories (Table 22, Figure 18) – an indication of improved reporting. Table 22 also shows that a slightly larger proportion of breeds moved from the at risk category into the not at risk category (7.4 percent) than vice versa (4.6 percent). The absolute figures are 60 breeds and 59 breeds respectively. Of the local breeds at risk in 1999, 1.6 percent had become extinct by 2006, and among

TABLE 21
Changes in risk status of local breeds (1999) reclassified as transboundary breeds (2006)

Risk status in 1999	Number of breeds in 1999	Risk status in 2006			
		at risk	not at risk	extinct	unknown
at risk	87	51%	45%	0%	5%
not at risk	124	3%	97%	0%	0%
extinct	9	44%	11%	22%	22%
unknown	56	21%	39%	0%	39%

FIGURE 18
Changes in risk status of local breeds from 1999 to 2006

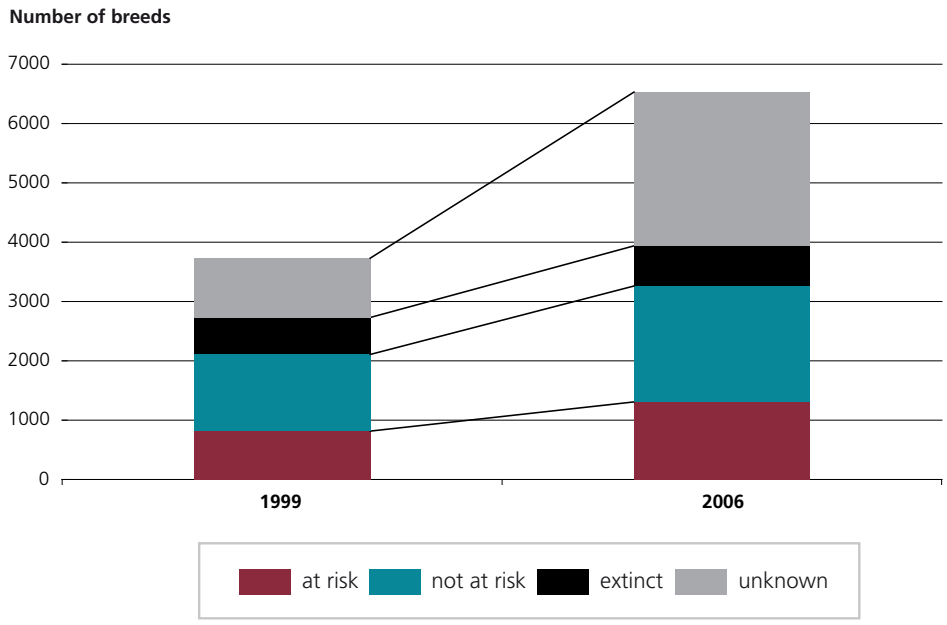


TABLE 22
Changes in risk status of local breeds from 1999 to 2006

Risk status in 1999	Number of breeds in 1999	Risk status in 2006			
		at risk	not at risk	extinct	unknown
at risk	815	91%	7%	2%	0%
not at risk	1 295	5%	93%	0.2%	2%
extinct	623	2%	0%	97%	0%
unknown	999	8%	10%	1%	81%

among the local breeds not at risk in 1999, 0.2 percent had become extinct.

The number of new local breeds reported, and their risk status categories are presented in Table 23. The relatively large number of breeds classified as being of unknown risk status is a result of the inclusion of breeds mentioned in the Country Reports, most of which did not include population data.

TABLE 23
Risk status of local breeds reported after 1999

	Risk status in 2006				Total number
	at risk	not at risk	extinct	unknown	
Number of breeds	414	575	54	1 758	2 801

PART **1**

7 Conclusions

In the period from 1999 to 2006 the coverage of breed diversity in the Global Databank was further improved. However, breed-related information remains far from complete. For more than one-third of all reported breeds, risk status is not known because of missing population data. In Africa and the Southwest Pacific, for example, population size has not been reported for over two-thirds of breed populations.

The creation of the new transboundary breeds category (linking of national breed populations with a common gene pool) has eliminated the unrealistic risk status estimations for these breeds that occurred because calculations were based on population data at the level of the individual country. The linking of breeds was based on expert knowledge; more objective criteria for judging what constitutes a common gene pool need to be developed and applied in the future. The differentiation of transboundary breeds as regional or international was carried out in a formalized way, according to whether the respective breed is present in one or more than one SoW-AnGR region. Nonetheless, some breeds classified as international (e.g. those present on both sides of the border between the Africa and the Near and Middle East regions) have quite a limited distribution and would be better treated as regional transboundary breeds. Furthermore, in this first attempt to classify breeds according to their distribution, the population size of transboundary breeds in the respective countries was not considered, meaning that in some countries the report of a breed's presence may represent a small population that will only be temporarily present. A more differentiated distinction needs to be developed, as this classification has proved very useful for identifying patterns of AnGR exchange. It will also be useful for identifying cases in which regional collaboration in breed management is needed.

The two transboundary breed groups (regional and international) need to be distinguished with respect to their risk status. Breeds with a truly international distribution and exchange pattern are not under threat in terms of population size. However, in the case of breeds such as the Holstein-Friesian, a decline in the within-breed diversity that underlies efficient selection programmes may become a problem. Though regional transboundary breeds are found in several countries, some may be kept by marginalized ethnic groups and, thus, may become threatened along with the livelihood strategies of their keepers.

Measuring diversity on the basis of the number of breeds tends to overestimate genetic diversity in Europe and the Caucasus, where a long tradition of breeders' associations has led to the distinction of breeds that in some cases are very closely related. The contribution of some breeds to genetic diversity may, therefore, be quite small. It should, however, be noted that most studies of fancy breeds in developed countries reveal that these breeds add to overall diversity and may have a high conservation potential. The picture of diversity is further confounded by the advanced state of reporting in some regions, such as Europe and the Caucasus, and North America, where an almost complete coverage of existing breeds has been achieved.

For the identification of trends in erosion, local breeds give a clearer indication than do transboundary breeds (for which movement between categories and the higher number of national breed populations reported in 2006 confound the picture). The changes in risk status category among the local breeds already reported in 1999 were rather small, and do not indicate an improvement in the situation. The reasons for the movements between risk status categories are largely unknown. The question of whether conservation programmes have contributed to an increase in population size can only be answered on a case-by-case basis, as information as to which threatened breeds are covered by conservation programmes is incomplete. It is alarming that 45 percent of the newly reported local breeds for which

population data are available are either at risk or already extinct.

Besides missing population data, a big weakness of the current monitoring of breed erosion is that it does not capture genetic dilution of local breeds by uncontrolled cross-breeding – a problem which is considered by many experts to be a major threat to AnGR diversity. Population size and structure as sole indicators of risk status may, therefore, be misleading. To arrive at a more comprehensive picture, more details of the geographical location of local breeds would be required, along with information on the distribution of imported live animals and genetic material in the country in question.